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ABSTRACT

This paper suggests that if reflection is a powerful vehicle in assisting the individual in grappling with complex ideas and concepts and it facilitates the assimilation of such ideas into a person's belief system, then reflection should be considered an integral part of teacher education programs. This study investigated whether the reflections of preservice teachers enrolled in a K-8 mathematics methods course indicate elements related to change. It is concluded that reflection can be an important part of the methods course. The level of the students' responses and the indications that such activities lead to the development of vital perspectives on the teaching and learning of mathematics would warrant further studies in the area, and would indicate that reflective practices can be an effective agent in facilitating the type of change necessary to support mathematics reform. (Contains 10 references.) (ASK)

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Facilitating Change:

The Role of Reflection in Pre-service Mathematics Education

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Opportunities to contemplate the nature of teaching and learning should follow naturally from the experiences which students are given in mathematics methods courses. This should be a natural outgrowth of such courses. The truth is, however, that the act of reflecting is a complex process and requires the development of skills which may not be a product of classroom practices or teaching methodologies.

John Dewey provided such a characterization of the act of reflection. He defined reflective thinking as the "active, persistent and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it" (Dewey, 1933). Judy Eby (1977) elaborated on these three adjectives in her discussion of reflection. Active indicates a voluntary act by individuals who take responsibility for their own personal actions and search for information and solutions. Persistence carries with it a stick-with- it-ness in dealing with issues in-depth even if those issues may be controversial or uncomfortable to the individual. Careful implies a level of concern both for self and others.

Research and Reflection

Research indicates that reflective actions help to elucidate beliefs and convictions. Stark (1991) found that writing journals and other personal reflections by student teachers served as a means of clarifying thoughts and values. She also identified personal biographies as an important influence upon individuals' perceptions of the experiences they encounter. These frames of reference may be guided by interpretations of pedagogical knowledge, built from past and present experiences (Jadallah, 1996).

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Reflection also assists in developing understanding of complex issues related to learning. Kroll and LaBoskey (1996) found that journals helped students engage in constant reflection of both teaching experiences and their coursework. Such a level of reflectiveness was viewed as essential in promoting understanding through the repeated considerations of important concepts in different contexts.

One of the most important benefits of reflection is the facilitation of change in a student's ideas about teaching and learning. Kettle and Sellars (1996) posit that there is evidence that change is facilitated as individuals reflect critically on their theory and try to adapt it in light of new knowledge and experience. Stark (1991) analyzed two cases of student teachers and concluded that reflection positively assisted the student teachers in their professional development. Students who are 'armed' with critical reflection skills are better able to evaluate their practical and intellectual experiences and accommodate these into their growing schema of teaching and learning.

Definition of the Problem

If reflection is a powerful vehicle in assisting the individual to grapple with complex ideas and concepts, thus, facilitating the assimilation of such ideas into one's belief systems, then reflection should be considered as an integral part of teacher education programs. This is especially important to such areas which are experiencing attempts at reform of the curriculum, including ideas related to teaching and learning.

Thus, this study investigated the following question:

Do the reflections of pre-service teachers enrolled in a K-8 mathematics methods indicate elements related to change?

Sample

This exploratory study will draw from the reflections of over 100 junior and senior undergraduate education majors at a midwestern university. All students have previously completed at least one methods course and are predominately female.

Data Collection

Students were asked to keep a journal in which they reflected on each class session. Students were encouraged to complete these reflections as quickly as possible after the completion of a particular class session. Based upon preliminary experiences with reflection, students were asked to write reflections which addressed three key areas. Initial attempts in implementing reflective practices demonstrated that students did not possess the skills to systematically contemplate key issues related to teaching and learning. Therefore, these prospective teachers were instructed to reflect on the following areas:

1. Content and their role as student.
2. Content and their role as teacher.
3. Content and the ultimate impact on student.

Each student completed approximately thirty such reflections over the space of one semester. The reflections were collected at the end of the course; however, the reflections were read during the course and comments and questions were often generated to encourage students to follow through on ideas which were viewed as important to their growth as teachers of mathematics.

Analysis of Data

The data were analyzed using a qualitative framework. The responses were categorized based on the homogeneity and heterogeneity of the statements. This was done to characterize those aspects of the reflections which were common across the majority of

the students. The reliability of the classification scheme which emerged has not yet been determined. It is the intent of the research to follow up the initial findings of this study.

Results

The preliminary findings may be summarized as follows:

1. Reflection assists students in realizing the impact of previous mathematics experiences on their own attitudes toward learning and teaching mathematics.
2. Reflection supports students in assessing their own difficulties with the content of mathematics.
3. Reflection facilitates changes in one's philosophy toward teaching and learning.

The importance of reflection in helping students deal with their previous mathematics experiences can be seen in the following student's writing.

> What I remember is memorizing rules for different operations. It was never explained why. We memorized our multiplication tables but we were never required to understand that '3 X 5' was 3 groups of 5 or 5 groups of 3. I think the teachers took it for granted that we would know this.

Another student referred to her experiences as the two R's: rote memorization and regurgitation. While many students could not recall much about their elementary or middle school experiences, those who did recall the nature of those experiences predominately depicted them in the same manner: classrooms where drill and memorization were routines and worksheets and dittos were frequent. Students who had experiences which were closer to those of the current reform efforts consistently spoke favorably of their math experiences.

Reflection also assisted students in assessing areas of weakness. Such self evaluations are essential if students are to begin to address areas which might present challenges in teaching that material to students. One student admitted that he had always had difficulty with place values and never saw them concretely. He continued that he still did not feel comfortable with the concept and thought that additional information should be sought. Another student discussed how they had come to understand multiplication of polynomials through concrete manipulations: "At first I did not grasp multiplication of polynomials. Now, I can really see that working with the manipulatives helps make the concept concrete. When I went to the station and was able to see $(x + y)(x + 2y)$, it all fell into place." Such comments were prevalent throughout the reflections. Students frequently made references to how they had come to understand a concept at a deeper level. Such information not only indicated that students were assessing their own level of mathematical knowledge but, the responses indicated that students were valuing the methods used in the methods course.

The students' reflections also demonstrated that the process facilitated change in their philosophies related to teaching and learning mathematics. The importance of the process standards from NCTM is evident in the following response from one student. As teachers, it is important to develop activities which require a 'pursuit of knowledge' as this did. An exemplary pursuit of knowledge will incorporate mathematical reasoning, mathematical communication and problem solving. It should also instill a stronger value of mathematics in the students and allow them to use and extend their conceptual and procedural knowledge. This implies that the task will usually require some moving around, some active research and/or measurement. The critical point is that they are solving a real problem, as we were. This brings about yet another implication for teaching. When teaching measurement, area, volume, it is important to measure real things. This quote, like many of the reflections, revealed that students began to incorporate many ideas from previous classes into their responses for new material and ideas. Such a level of reflection

would seem to indicate the development of ideas related to teaching and learning of mathematics. Such indications are viewed as a vital link in moving students to a philosophy which supports mathematics education reform.

The following statement clearly outlines how important reflection can be in helping students define what they believe to be important in the teaching and learning of mathematics. The lesson emphasized the importance of being clear, concise speakers when teaching. It also demonstrated the frustration students feel when they are not allowed to ask questions. This task encouraged me to look at the bigger picture and explain myself in the most concise manner possible. For example, I..... Remembering the following guidelines will have positive educational consequences for students (sigma) allow students to ask questions, encourage (do not discourage) asking questions (sigma) speak in a clear and concise manner (explain it in the simplest manner possible) (sigma) explain the big picture (there is no need to muddle the picture by fragmentation). If our goal in our methods class is to affect the way in which students will teach mathematics, this statement offers support that our efforts make an impression on how students view the impact of the act of teaching on mathematics learning. This is an essential factor in the eventual translation of those ideas into practice.

Conclusion

This exploratory study indicated that reflection can be an important part of the methods course. The level of the students' responses and the indications that such activities lead to the development of vital perspectives on the teaching and learning of mathematics would warrant further studies in the area and would indicate that reflective practices can be an effective agent in facilitating the type of change necessary to support mathematics reform.

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